Modules

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Objectives

- $\scriptstyle\rm I.$ Understand the relevance to use modules and packages.
- 2. Be able to install some widely used Python packages
- 3. Be able to apply some modules and packages of both Python Standard Library

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Introduction

You loose everything when exit the interpreter

• Solution: Write it down in a script

When a script becomes big, it is difficult to maintain

Solution: Split your script in several ones

As you get more scripts, you will need to reuse your functions

- Solution: Create a module
- Module: A file that contains definitions, functions and classes

If a module is too big, it is too difficult to maintain

- Solution: Create a package
- Package: A module of modules



Introduction (II)

Introduction

Why modules?

- Main function: Organization.
- **Reuse**: To provide software solutions, that have been proven to work, to solve similar problems.



Using modules

Creation and Implementation

Modules

A module is just a Python script with . py extension

```
def fib(n):
      """Print a Fibonacci series up to n """
      a. b = 0.1
      while a < n:
         print(a, end= ' ')
          a, b = b, a+b
      print()
  def fib2(n):
      """Print a Fibonacci series up to n """
      result = [] # Declare a new list
      a, b = 0, 1
      while a < n:
          result.append(a) # Add to the list
          a, b = b, a+b
      return result
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```



Using modules

Where is it stored?

Accessible and reusable module:

- Set path in the file directory where the module is stored.
- Variable PYTHONPATH



How do I use them? (I)

```
>>> import fibo
>>> fibo.fib(1000)
1 1 2 3 5 8 13 21 34 55 89 144 233 377 610 987
>>> fibo.fib2(100)
[1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89]
>>> fibo. name
'fibo'
>>> fib = fibo.fib
>>> fib(100)
1 1 2 3 5 13 21 34 55 89
```



How do I use them? (II)

A module can import other modules

- Name conflicts may arise: Each module has a symbol table
- It means you should invoke it as modname.itemname

It is possible to import items directly

- from module import name1, name2
- from module import *
- It uses the global symbol table (no need to use the modname)

```
>>> from fibo import fib, fib2
>>> fib(100)
1 1 2 3 5 8 13 21 34 55 89 144 233 377 610 987
```



Using modules

How do I use them? (III)

List zip file contents (file.zip must exist. Open in read mode)

```
import zipfile

file = zipfile.ZipFile("file.zip", "r")

# list filenames
for name in file.namelist():
    print(name)

# list file information
for info in file.infolist():
    print(info.filename, info.date_time, info.file_size)
```

Several examples here: http://pymotw.com/2/PyMOTW-1.132.pdf



Using modules

How do I use them? (IV)

Error while importing:

- The module does not exist.
- The module name has not been well written.
- The module is not on the search path of Python modules:
 - 1. By default, it searches in the current directory.
 - 2. If it does not find it here, it then searches in the directories of the environment variable PYTHONPATH.
 - echo \$PYTHONPATH (from Linux/Windows console)
 - import sys print(sys.path)
 - 3. If it still does not find, it then searches in the installation directories of Python.

Warning: PYTHONPATH is not PATH



Modules as scripts (I)

When a module is imported, its statements are executed

- It declares functions, classes, variables ...
- ... and also executes code
- It serves to initialize the module

Very useful to use modules as programs and libraries



Executing modules

Modules as scripts (II)

```
fibo2.py

def fib(n):
    """Print a Fibonacci series up to n """
    a, b = 0, 1
    while a < n:
        print(a, end= ' ')
        a, b = b, a+b
    print()

if __name__ == "__main__":
    import sys
    fib(int(sys.argv[1]))</pre>
```

```
(In Linux console)
$ python3 fibo2.py 50
1 1 2 3 5 8 13 21 34
```

(In Python interpreter)
>>> import fibo2
>>> fibo2.fib(50)

1 1 2 3 5 8 13 21 34

Compiled Python files

We said Python is an interpreted language

• ... this is almost a lie

Python, as other interpreted languages, has a speed-up trick

It can use bytecode, just as Java

Bytecode: Intermediate code between machine code and source code

- Faster than source code, slower than machine code.
- It is transparent to the programmer.
- The first time a .py file is executed, it is compiled automatically, generating a .pyc file.



Content of a module

The dir() function

Very usefull to get an insight to a module

- It returns the names defined in a module
- Without arguments, it returns your names

```
>>> import fibo, sys
>>> dir(fibo)
['__name__', 'fib', 'fib2']
>>> dir()
['__builtins__', ... , '__spec__']
>>> variable = 'Hello'
>>> dir()
['__builtins__', ... , '__spec__', 'variable']
```



Package concept (I)

If a module gets too big, many problems arise

- Name collisions
- It is good to organize modules in a bigger structure: Packages

Packages can be seen as "dotted module names"

- It is just a module that contains more modules
- Make life easier in big proyects
- The name A.B designates a submodule B in a package named A

Must contain a __init__.py file in the root directory

Executed when the package is imported for the first time



Package concept (II)

Sound module structure

```
sound/
                           Top-level package
                           Initialize the sound package
      init .pv
      formats/
                           Subpackage for format conversions
              __init__.py
              wavread.py
              wavwrite.py
              aiffread.py
              aiffwrite.pv
              auread.pv
              auwrite.py
      effects/
                           Subpackage for sound effects
              __init__.py
              echo.pv
              surround.py
              reverse.py
      filters/
                           Subpackage for filters
              __init__.py
              equalizer.py
              vocoder.py
              karaoke.pv
              . . .
```

Importing a package (I)

Ways to use a package

Import an individual module

- import sound.effects.echo
- Use function as sound.effects.echo.echofilter(input, output)

Alternative way to import an individual module

- from sound.effects import echo
- Use function as echo.echofilter(input, output)

Alternative way to import an individual module

- from sound.effects.echo import echofilter
- Use function as echofilter(input, output)



Importing a package (II)

Imagine we run from sound import *

- In theory, it would import the whole package
- In practice, it would take too much time

There is a convention to avoid waste of resources

- There may be a variable __all__ defined in __init__
- __all__ contains modules to be imported

```
sounds/effects/__init__.py
```

```
__all__ = ["echo", "surround", "reverse"]
```



Installing packages

Command-line automatic tool: pip (sometimes pip3)

• Very similar to apt-get in Linux

pip usage (from OS terminal)

\$ python -m pip install SomePackage

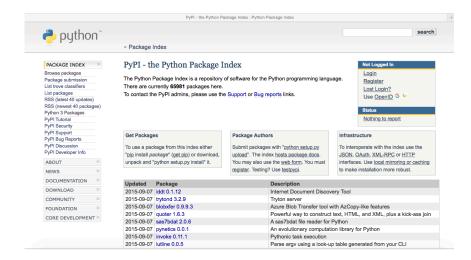
or

\$ pip install SomePackage

\$ pip install Pillow



Packages What has been developed?





OS module

Functions to manipulate files and processes

- Functions for managing files and paths: dir(os.path)
- Create directories. Example: os.mkdir('data')
- Current working directory: os.getcwd()
- Moving to a certaing directory. Example: os.chdir('data')
- Value of an environment variable. Example: os.chdir(os.environ['HOME'])
- Rename a file. Example: os.rename('fich1.py', 'palindrome.py')
- Deleting a file. Example: os.remove('practica1.py')
- List the files in the current directory. Example: os.listdir(os.curdir)
- List the files in a certain directory. Example: os.listdir('c:\\data')
- Call operating system (execute OS services). Example: os.kill, os.execv, etc.

Warning!: Linux and Windows use different path separator (os.path.sep)

- Linux: myscripts/script.py
- Windows: myscripts\script.py



It provides access to some variables maintained by the interpreter at run-time.

- List the arguments passed to script on the command line: sys.argv
- Python output. sys.exit
- Files for access to input, output and standard error of the interpreter: sys.stdin, sys.stdout, sys.stderr, respectively.



Example

```
example_sys.py
import sys
# datos introducidos por teclado
data = sys.argv
print('data = ', data)
print("{0} arguments were passed to the script {1}: ".format(
    len(sys.argv) - 1, sys.argv[0]))
for arg in sys.argv:
    print(arg)
```



- It provides functions related to the measurement of time.
- Python provides the date and time of three ways:
 - Tuple: year-month-day-hour-min-sec-dayweek-day year-x (tup)
 - String (str)
 - Total of seconds since an origin (sec)



- Current time: time()
- Time elapsed since the start of the execution. process_time()
- Pause n seconds. sleep()
- GMT.gmtime()
- Local time.localtime()
- Convert the tuple to a character string. asctime()
- Convert the tuple to a string. strftime()
- Convert the tuple to seconds. mktime()
- Convert the seconds to a string. ctime()
- Convert the string to a tuple. strptime()
- •





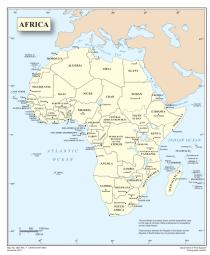
Example 1: Open a web browser

```
browser.py
import webbrowser
url = input('Give me an URL: ')
webbrowser.open(url)
```



Example 2: Create a thumbnail

```
thumbnail.py
from PIL import Image
size = (128, 128)
saved = "africa.jpg"
im = Image.open("africa.tif")
im.thumbnail(size)
im.save(saved)
im.show()
```



Example 3: List a directory contents

```
dir.py
import os
os.system("clear")
path = input("Specify a folder >> ")
for root, dirs, files in os.walk(path):
   print(root)
   print("----")
   print(dirs)
   print("----")
   print(files)
   print("----")
```

(Source)



Other cool code examples

Example 4: Send an email with Gmail

gmail.py

```
"""The first step is to create an SMTP object,
each object is used for connection
with one server."""

import smtplib
server = smtplib.SMTP('smtp.gmail.com', 587)

# Next, log in to the server
server.login("youremailusername", "password")

# Send the mail
msg = "\nHello!" # /n separates the message from the headers
server.sendmail("you@gmail.com", "target@example.com", msg)
```

(Source)



Other cool code examples

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